

Attachment 4 provides a complete, detailed description of the Sacramento Central Groundwater Authority Basin Management Objective Threshold Development and Recharge Mapping Project consistent with the *Guidelines and Proposal Solicitation Package Local Groundwater Assistance Grant Program, May 2012* (California Department of Water Resources, May 2012).

4.1 Project Summary

The Central Sacramento County Groundwater Basin stakeholders, in coordination with the Sacramento County Water Agency and the Water Forum Successor Effort have developed the Central Sacramento County Groundwater Management Plan (CSCGMP). The CSCGMP, adopted by the Sacramento Central Groundwater Authority (SCGA) on November 8, 2006, represents a critical step in establishing a framework for maintaining a sustainable groundwater resource for the various users overlying the basin in Sacramento County between the American and Cosumnes Rivers. It includes specific goals, objectives, and an action plan to provide a “road map” for SCGA as the steps necessary to manage the basin are taken in coordination with the various stakeholders.

The CSCGMP is a tool used to help ensure a long-term reliable water supply for rural domestic, agricultural, urban, business/industrial, environmental, and development uses in the region. The CSCGMP has defined five Basin Management Objectives (BMO) which are quantifiable and measureable. These BMOs are specific objectives that assist the SCGA in meeting the long-term goals of management of the groundwater basin. The details of the BMOs are defined in Section 4.5 of this proposal. Each BMO has been addressed at various levels.

The proposed project is “BMO Threshold Development and Recharge Mapping.” This project will help meet the long-term goals of the CSCGMP. In order to achieve this, the proposed project is intended to address two specific areas:

- Improvement of groundwater management through the development of thresholds necessary to implement and monitor a quantitative, measureable BMO for groundwater levels
- Improvement of the understanding of recharge in the Central Basin to allow for more informed land use and water management decisions

Focus Area One: Thresholds for the groundwater level BMO (BMO Number 2 in the CSCGMP) will be developed following the procedures described in Appendix B of the CSCGMP. These procedures use historical groundwater data and simulation results from the integrated hydrologic model. The objective is to establish a measureable “bandwidth” of groundwater levels based on the maximum and minimum simulated groundwater elevations as simulated by the Sacramento Area Integrated Water Resources Model (SacIWRM) 2030 Future Conditions Baseline (2030 Baseline). The 2030 Baseline will be updated as part of this proposed project to include the latest data and information, as well as the most recent management activities in the basin. The resulting bandwidths will be used in SCGA’s hydrologic data management system, which was designed to automate the display of compliance with BMO Number 2 using these thresholds. The hydrologic

data management system is maintained and operated in the HydroDMS platform. The HydroDMS is a web-based DMS which allows for SCGA staff, stakeholders, and public to utilize the water resources data to better manage the basin based on informed decision making protocols.

Focus Area Two: The conceptual understanding of recharge will be improved through two processes. The first process will merge available data from SacIWRM to map the spatial distribution of recharge sources to the Central Basin. This will include river recharge, flows from the foothills, and surface recharge from rainfall and irrigation applied water within the SCGA area. Additionally, a field study analyzing primarily stable isotopes, cations, and anions will be used to identify the portions of the Central Basin that are recharged from surface water courses. This will allow for improved understanding of the importance of surface water recharge compared to aerial recharge and recharge from the foothills to the east.

The results of this project will be used in SacIWRM to evaluate the impact of land and water use changes on the surface water resources in the Central Basin. With this knowledge, more informed decisions on land uses, conjunctive use, and impacts from development can be made. Finally, the recharge map also allows for compliance with AB 359 (Huffman) once incorporated into the CSCGMP during the next update, anticipated in 2016.

4.2 Project Goals

There are two primary goals of the proposed project:

- **Goal 1:** To improve groundwater management through the development of thresholds necessary to implement and monitor a quantitative, measureable BMO for groundwater levels
- **Goal 2:** To improve the understanding of recharge in the Central Basin to allow for more informed land use and water management decisions

Goal 1: The development of thresholds will improve SCGA's ability to convey regional groundwater conditions to decision-makers. Currently, groundwater conditions are summarized as groundwater elevation contour maps, making changes over time difficult to recognize for those unaccustomed to such formats. The BMO was designed in the CSCGMP to include the thresholds, allowing for the display of color-coded polygons throughout the Central Basin, as shown in Figure 4-1. HydroDMS provides the ability to automate the display of the color-coded polygons, allowing for efficient development of maps for reports for decision makers and Central Basin managers. Such color-coding will highlight areas of concern and help focus water management activities where they are most needed.

Goal 2: The recharge component will seek to improve the conceptual understanding of the Central Basin through identification of sources of groundwater recharge as well as the relative magnitude of each source. Contours of recent groundwater levels (see Figure 4-2) indicate flow from the foothills in the northeast and losses from surface water courses. These recharge sources help meet pumping needs in the cones of depression in the area between the rivers. An improvement in the understanding of the recharge sources for the Central Basin will help identify potential impacts from development in the foothills and in the eastern part of the county. It will also help improve the conjunctive management of surface water and groundwater supplies, which is particularly important along the Cosumnes River basin, where surface water / groundwater interaction is critical for several habitat restoration projects.

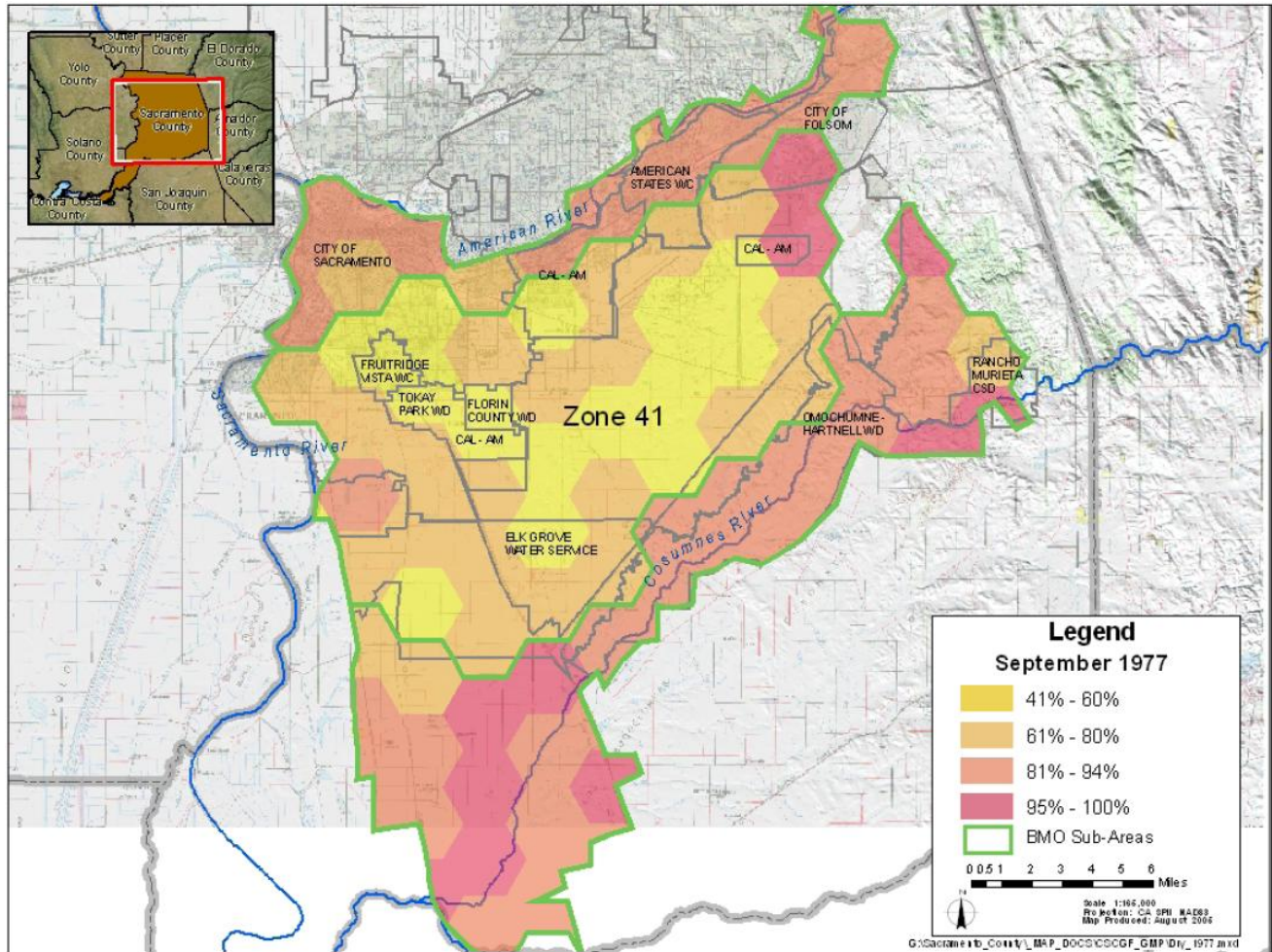


Figure 4-1. SCGA Area with Sample Color-Coded Polygons



4.3 Needed Facilities

The proposed project is a planning effort and requires no new facilities. Existing well facilities will be used to collect groundwater samples. The wells will be selected from the existing monitoring, remediation, and production wells owned and maintained by SCGA member agencies and available for use in this proposed project (see Figure 4-3). These member agencies are public municipalities or private water purveyors regulated by the CPUC.

Additionally, the proposed project will utilize the existing HydroDMS by providing thresholds for BMO compliance as well as updating the existing SacIWRM for use in developing the BMO thresholds.

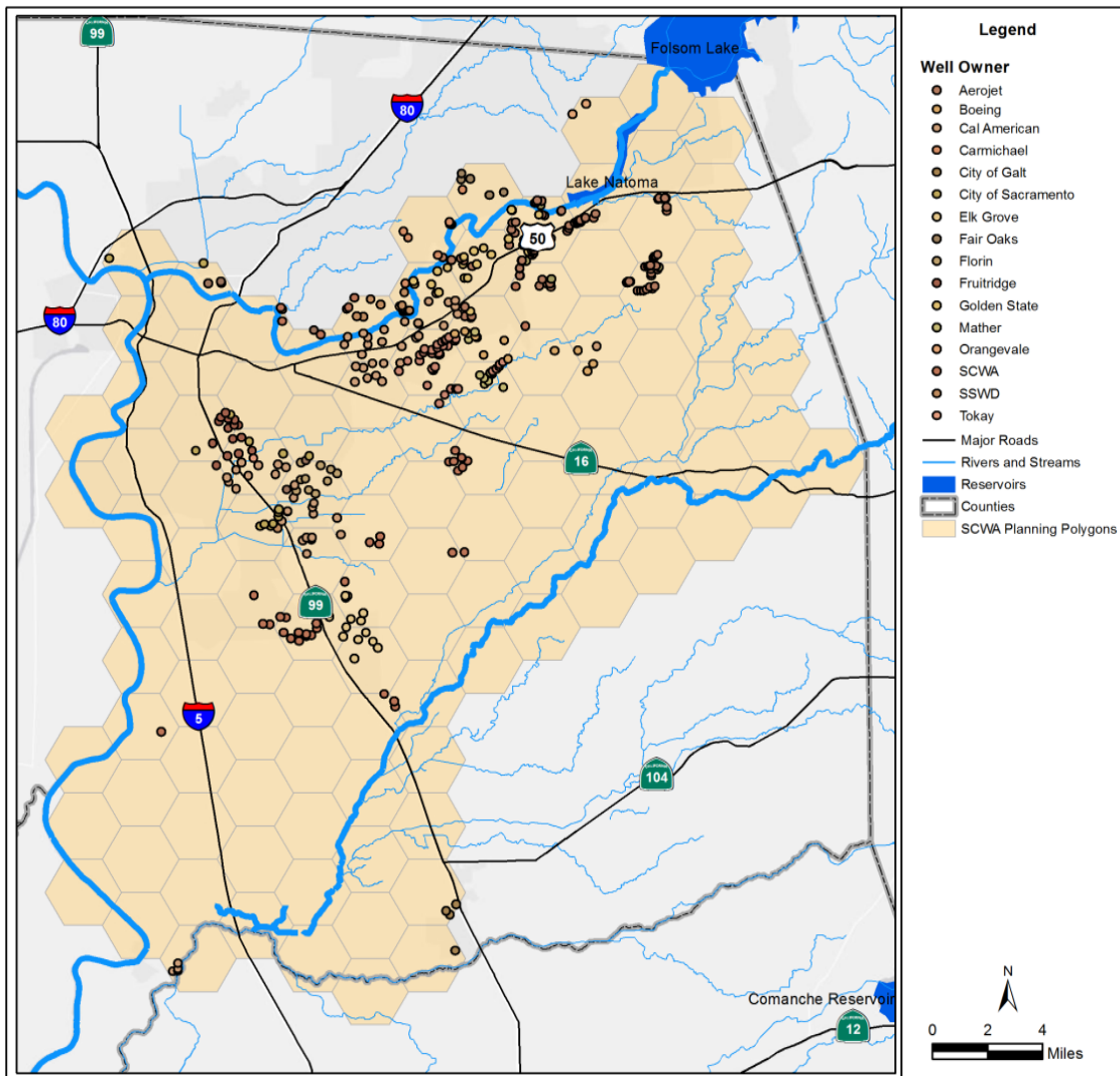


Figure 4-3. SCGA Member Agency Wells in the SCGA Area for Consideration in Groundwater Sampling.

4.4 Area Covered

The project covers the full area of SCGA, which is shown in the blue outline in Figure 4-2. This is the Central Basin, which encompasses the area bounded by the American River on the north, north of the southern boundary of the Omochumne-Hartnell Water District, the Cosumnes and Mokelumne rivers on the south, the Sacramento River on the west, and Sierra Foothills on the east.

4.5 Supporting Goals and Objectives of the GWMP / Relevance to GWMP

In February 2006, the CSCGMP was accepted by the Central Sacramento County Groundwater Forum and the Water Forum Successor Effort. This document was the result of 6 years of negotiations and agreements between various stakeholders in the region. The CSCGMP is a planning tool that assists basin stakeholders in maintaining a safe, sustainable, and high quality resource for all groundwater users within the Central Basin.

The goals of this proposed project are consistent with and support the goal and objectives of the CSCGMP. The goal of the CSCGMP is:

To ensure a viable groundwater resource for beneficial uses including water for purveyors, agricultural, agricultural residential, industrial, and municipal supplies that support the Water Forum Agreement's coequal objectives of providing a reliable and safe water supply and preserving the fishery, wildlife, recreational, and aesthetic values of the lower American River. In addition, the CSCGMP recognizes the need to maintain and enhance flows in the Cosumnes River because of its ecological significance.

The CSCGMP provides for the review of current and future water supply and demands and contains BMOs. Each BMO focuses on managing and monitoring the Central Basin to benefit all groundwater users within the basin. The CSCGMP also contains “trigger points” and remedies to ensure full implementation of the individual BMOs. The five BMOs and their relevant sections in the CSCGMP are:

1. Maintain the long-term average groundwater extraction rate at or below 273,000 acre feet/year (Section 3.1.1)
2. Maintain specific groundwater elevations within all areas of the Central Basin consistent with the Water Forum “solution” (Section 3.1.2)
3. Protect against any potential inelastic land surface subsidence by limiting subsidence to no more than 0.007 feet per one foot of drawdown in the groundwater basin (Section 3.1.3)
4. Protect against any adverse impacts to surface water flows in the American, Cosumnes, and Sacramento rivers (Section 3.1.4)
5. Meet water quality objectives (Section 3.1.5) including:
 - Total Dissolved Solids (TDS) concentration of less than 1,000 milligrams per liter (mg/l)
 - Nitrate concentration of less than 45 mg/l
 - Volatile Organic Compounds (VOC)

The development of thresholds through this proposed project will complete SCGA’s ability to quantitatively monitor **BMO Number 2**. The CSCGMP specifies the criteria for development of the thresholds and the actions to occur should those threshold be crossed. However, it did not develop the actual thresholds, as the CSCGMP stakeholders felt it was important to first establish governance, monitoring, and tools, which was beyond the scope of the CSCGMP.

Without such thresholds, the biennial reports can only provide information in the form of contour maps and hydrographs. Lacking thresholds makes utilization of the information difficult for decision makers and can lead to difficulty in recognizing changes that can occur slowly over the period of years or decades. By developing the thresholds for **BMO Number 2**, the biennial reports and data available at all times through SCGA’s HydroDMS data management system can provide the necessary information summarized in a manner to support management decisions.

The improved understanding of recharge that will be obtained through the development of the recharge map and recharge field study will also support **BMO Number 2** and will further support **BMO Number 4**. Maintaining specific minimum groundwater elevation involves managing groundwater production as well as managing recharge. The Central Basin is anticipating significant growth in the coming decades. Identification of critical recharge areas can help drive land use decisions regarding development in these areas. These may include preservation of recharge areas or managing development in a way that incorporates the improved understanding of the changes such development would bring in the groundwater system. The improved conceptual understanding of the Central Basin can guide land use and water management decisions to help meet **BMO Numbers 2 and 4** and ultimately the **overall goal**.

Finally, the recharge mapping component of the proposed project provides important technical information to support the CSCGMP, allowing for compliance with AB 359 (Huffman). AB 359 (Huffman) requires a map identifying the recharge areas, as defined, for the groundwater basin to be included in the groundwater management plan. The map prepared under this proposed project will be incorporated into the CSCGMP during the next update, anticipated to be in 2016.

4.6 Quality and Usefulness of the Information

A critical part of the quality and usefulness of the information from this project is the timing. In October 2011, the Sacramento County Water Agency completed the Vineyard Surface Water Treatment Plant, a \$200 million facility that can treat up to 50 million gallons of Sacramento River water per day and will ultimately expand to treat up to 100 million gallons per day (mgd). The plant is currently delivering 15 mgd. As the plant output increases in size and as this surface water recharges to the aquifer, the ability to identify groundwater naturally recharged by surface water will be greatly reduced, as the source of water for the Vineyard Plant is the Sacramento River, which has a similar isotopic fingerprint to the American and Cosumnes rivers. Thus, irrigation recharge will have the same isotopic fingerprint as water recharged by the American and Cosumnes Rivers. This proposed project will collect samples before the ability to distinguish precipitation and irrigation recharge from surface water recharge is diminished. An improved understanding of the distribution of recharge between these sources is important for decision makers to make policies related to conjunctive use planning, land use planning, and water use planning.

In addition, high quality, useful information will come through robust analysis and proper quality assurance and quality control. The analysis will include the latest available data and standard and accepted methods, such as the existing HydroDMS and SacIWRM tools and the analytical methods used by the University of California Davis Stable Isotope Facility to analyze stable isotopes.

Development of the thresholds will use the methodology developed in Appendix B of the CSCGMP. This methodology was fully vetted and approved with the adoption of the CSCGMP. Approval by the SCGA Board will be sought for any deviation from the methodology in the CSCGMP. To gain high quality, useful information from the modeling required as part of the development of the threshold, the existing and widely accepted regional integrated hydrologic model SacIWRM will be updated to include the latest available hydrologic data. This will involve an update to extend the end of the modeling period from the 1970-2004 time period to a new end month of September 2011. Any new data collected as part of the effort will also be incorporated into the HydroDMS to provide greater utility.

The recharge study will use accepted isotopic techniques as well as anion and cation analyses to provide new information on the sources of recharge in the Central Basin. The quality of the information will be driven by the standard methods for sampling and laboratory analysis. Additionally, the analysis of the lab results will be performed by professional geologists and engineers with experience in isotopic analysis.

Defining the relative contribution of surface water to the groundwater system is critical for accurate conceptual understanding of the basin hydrology, which drives regional groundwater management. The improved conceptual understanding of groundwater recharge will assist the region in planning for the anticipated tremendous growth in eastern Sacramento County over the next decades. Additionally, the completion of the BMO thresholds will provide a complete monitoring tool for SCGA decision makers, directing policies and efforts where most needed.

4.7 Technically Feasible Methods

The methods proposed are made feasible through extensive work within the Central Basin to advance groundwater management and through the large body of knowledge on stable isotope methods.

Development of BMO thresholds will build upon the groundwater management effort already in place in the Central Basin. The framework for the development of BMOs is included in Appendix B of the CSCGMP. This methodology was fully vetted and approved with the adoption of the CSCGMP. The SCGA Board provides a forum to communicate with stakeholders in the Central Basin, including the general public, to gather input on the methodology and results. The completion of this effort is possible only through the extensive resources developed by the SCGA and other basin stakeholders. These resources include the following:

- CSCGMP, which defines the thresholds and the actions, but does not develop the actual threshold values
- CSCGMP Appendix B, which includes the methodology for developing the threshold values
- SacIWRM, the regional integrated hydrologic model which serves as the basis for development of the threshold values
- Water Forum and 2010 Urban Water Management Plan (UWMP), which provide information on future basin conditions that serve as a basis for SacIWRM modeling
- HydroDMS, the regional data management system that contains extensive groundwater data and will provide information for this study as well as incorporate the resulting thresholds into the system for ease of future analyses
- Groundwater monitoring efforts by SCGA member agencies, California Department of Water Resources, and others providing the necessary data to perform the analysis

This network of resources is developed and ready for use in developing threshold BMOs for the Central Basin and for use to support recharge analyses.

The stable isotope methods proposed for the recharge effort have been utilized across the state and around the world to improve the understanding of recharge conditions. In California, such efforts have investigated the movement of water from recharge basins, the source of recharge between precipitation and imported irrigation water, and other recharge questions. The proposed project is similar in many aspects to these previous efforts.

The laboratory analysis of oxygen-18 and deuterium is specialized and readily available at the nearby UC Davis Stable Isotope Facility. Anions and cations is a standard analysis that can be performed by most laboratories.

4.8 Data, Technical Methods, and Analyses

Data required for the project are all readily available from within SCGA and its member agencies or from public sources. These data include the following:

- Groundwater level data, maintained by SCGA in the HydroDMS
- SacIWRM integrated hydrologic model, maintained by SCGA and available in-house
- Time series data for extension of the SacIWRM, available from identified, readily available public data sources (See Subtask 2.2 of the Workplan for details)

The following accepted technical methods are proposed for the model update, threshold development, groundwater sampling, and groundwater analysis:

- The extension of the Baseline will be performed using the existing SacIWRM. SacIWRM was developed using the Integrated Groundwater and Surface Water Model (IGSM), a comprehensive hydrologic model that simulates both surface water and groundwater flow systems, including the land surface processes, such as crop consumptive use. SacIWRM was developed in 1992 and has been used in approximately 20 applications in Sacramento County, indicative of stakeholder acceptance of model performance. The model was last updated in 2009.
- The threshold development will be based on the technical methods described in Appendix B of the CSCGMP. This appendix defines the basic methods to develop the thresholds and is incorporated into this project description and the proposed project work plan.
- Sample collection will follow the International Atomic Energy Agency's (IAEA) *Sampling Procedures for Isotope Hydrology*¹, with adjustments made to reflect any additional needs or procedures of the analytical laboratory. Further, sampling will follow the well owner's standard procedures for water quality monitoring, which are based on California Department of Public Health requirements and laboratory protocols.
- Analysis of water quality samples:
 - It is anticipated that analysis of oxygen-18 and deuterium will be performed using a Laser Water Isotope Analyzer V2. Such equipment is utilized at the UC Davis Stable Isotope Facility. For oxygen-18 and deuterium at natural abundance, each sample is injected eight times. The first four injections are discarded to eliminate memory effects and the average of injections Numbers 5-8 is used for isotope ratio calculations. For enriched and saline samples, the number of injections is increased to 10 and the average of injections Numbers 7-10 is used for isotope ratio calculations. Sample isotope ratios are standardized using a range of working standards calibrated against IAEA standard reference materials.
 - Anions and cations will be analyzed using standard methods, such as US Environmental Protection Agency (EPA) Method 300.0, 200.7, and 6010, and SM2320B, or equivalent.

4.9 Collaboration

SCGA was formed on August 29, 2006 through a Joint Powers Agreement (JPA) signed by the Cities of Elk Grove, Folsom, Rancho Cordova, and Sacramento and the County of Sacramento for the following purposes:

- To maintain the long-term sustainable yield of the Central Basin
- To ensure implementation of the BMOs prescribed by the CSCGMP
- To oversee the implementation of any well protection program that may be prescribed by the CSCGMP
- To manage the use of groundwater in the Central Basin and facilitate implementation of an appropriate conjunctive use program by water purveyors
- To coordinate efforts among those entities represented on the governing body of the JPA to devise

¹ International Atomic Energy Agency. *Sampling Procedures for Isotope Hydrology*. Accessed online on July 5, 2012 at <http://www-naweb.iaea.org/naweb/ih/documents/other/Sampling%20booklet%20web.pdf>

and implement strategies to safeguard groundwater quality

- To work collaboratively with other entities, including the Sacramento Groundwater Authority (SGA), the Southeast Sacramento County Agricultural Water Authority (SSCAWA) and other groundwater management authorities that may be formed in the County of Sacramento and adjacent political jurisdictions, to promote coordination of policies and activities throughout the region

SCGA is recognized as an essential component in implementing the groundwater management element of the Water Forum Agreement. The Water Forum Agreement is a package of linked elements with two, co-equal objectives: to provide a reliable water supply for planned development to the year 2030 and to preserve the Sacramento region's environmental crown jewel, the lower American River. Currently, SCGA consists of 16 members representing stakeholder interest groups including agriculture, agriculture/residential users, business, environmental/community organizations, local governments/public agencies, and water purveyors.

SCGA, through the Board of Directors, the regular meetings of that body, and the established web presence (www.scgah2o.com; see Figure 4-4), has established a method to inform groundwater users, stakeholders, and the general public about the project and to disseminate reports and data. The proposed project includes four presentations at Board meetings along with development of a website for the project and opportunities for detailed discussions with interested stakeholders. As part of the project outreach, private parties and other federal, state, and local agencies will be informed of the project, including:

- US Bureau of Reclamation
- EPA
- United States Geological Survey
- Department of Toxic Substances Control
- Regional Water Quality Control Board
- University of California – Davis
- State Water Resources Control Board
- Regional Water Authority
- SGA
- SSCAWA
- The Nature Conservancy

The project may be of interest to these agencies due to the importance to water supply, habitat, and the migration of known contaminant plumes.

4.10 Funding of Ongoing Use

The ongoing use of the project includes the implementation of the thresholds and the incorporation of the improved conceptual understanding of recharge.

The ongoing use of the thresholds requires no additional costs. The thresholds will be incorporated into the biennial reports, adding polygon- and threshold-based information to this report. This information will streamline the development of the water level discussion, especially given the integration and automation of the thresholds in the HydroDMS. Such streamlining will reduce overall costs of reporting.

Potential updates to an integrated hydrologic model may be needed to incorporate any refinements in the conceptual understanding of recharge as a result of the recharge analysis. Stakeholders in Sacramento County have proven their ability to update groundwater models to reflect changing conditions through the SacIWRM model, which has been successfully maintained and updated for nearly two decades. The continued usefulness of an integrated hydrologic model to analyze impacts of development projects and management efforts suggests that the improvement in the conceptual model will be incorporated into an

integrated hydrologic model in the future. SCGA anticipates the need for an updated model in 2016 as part of an anticipated CSCGMP update process. It is anticipated that SCGA funds will be used to complete this update.

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SCGA

Sacramento Central Groundwater Authority
Managing Groundwater Resources
in Central Sacramento County

Our Mission
To manage, protect and sustain the groundwater resources of the basin in Sacramento County between the American and Cosumnes Rivers consistent with the Water Forum Agreement for the benefit of the water use within the basin, and to coordinate with other water management entities and activities throughout the region.

Focus On:

Groundwater Management Plan
SCGA adopted its Groundwater Management Plan on November 8, 2006. The plan is an essential tool for ensuring the viability of the groundwater resource while supporting the objectives of the Sacramento Water Forum Agreement.
[Groundwater Management Plan](#)
- pdf (11.3MB)
[Groundwater Management Plan - Appendices](#)
- pdf (9.85MB)

Joint Powers Agreement
[Joint Powers Agreement](#)
- pdf (0.61MB)

2009-2010 Basin Management Report
[2009-2010 Basin Management Report](#)
- pdf (7MB)

SCGA CASGEM PLAN
[SCGA CASGEM PLAN](#)
- pdf (4.1MB)

Central Basin Well Protection Program
Nexus Study and Draft Ordinance
[Draft - Nexus Study for Well Protection Fee](#)
- pdf (96KB)
[Provisions for the Establishment of a Development Impact Fee](#)
- pdf (57KB)
[Appendix A - Zone 40 MP Hydrology Report](#)
- pdf (11MB)
[Appendix B - WRIME 2005 Impact Analysis](#)
- pdf (1MB)
[Appendix C - WRIME 2008 Refined Impact Analysis](#)
- pdf (28MB)

The Sacramento Central Groundwater Authority Board of Directors meets on the second Wednesday every odd month at 9:00 a.m. Meeting dates are listed below.
1/11/2012
3/14/2012
5/9/2012
7/11/2012
9/12/2012
11/14/2012

| 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 |

Meeting Date	Agenda	Minutes	Attachments
5/9/2012	[PDF]	[PDF]	FINAL Resolution SCGA Budget 12-13 20120509 - SGA's Water Accounting Frame Work Presentation to SCGA
4/26/2012	[PDF]	[PDF]	
3/14/2012	[PDF]	[PDF]	20120314 SIGNED BDL Authorizing Submittal of Application for AB 303 Grant Independent Auditors Report Managements Discussion and Analysis Basic Financial Statements and Required Supplementary Information Local Groundwater Assistance (AB 303) Grant Funding Opportunities Review of Groundwater Banking Programs
2/28/2012	[PDF]	[PDF]	
1/17/2012	[PDF]	[PDF]	
1/11/2012	[PDF]	[PDF]	

Figure 4-4 SCGA Website